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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|-----------------|-------------|----------------------|---------------------|------------------|
| 09 905,053 | 07 12 2001 | Hung-Tien Yu | 005552 | 3453 |

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APPLIED MATERIALS, INC.
Patent Department
P.O. Box 450A
Santa Clara, CA 95052

EXAMINER

LEE, HSIEN MING

| | |
|----------|--------------|
| ART UNIT | PAPER NUMBER |
|----------|--------------|

2823

DATE MAILED: 07/25/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

| | | | |
|------------------------------|-----------------|--------------|--|
| Office Action Summary | Application No. | Applicant(s) | |
| | 09/905,053 | YU ET AL. | |
| | Examiner | Art Unit | |
| | Hsien-Ming Lee | 2823 | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED. (35 U.S.C. § 133)
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☐ Claim(s) 1-23 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☐ Claim(s) 1-23 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on ____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. ____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s). ____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449) Paper No(s) <u>5</u> | 6) <input type="checkbox"/> Other: _____ |

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

The changes made to 35 U.S.C. 102(e) by the American Inventors Protection Act of 1999 (AIPA) do not apply to the examination of this application as the application being examined was not (1) filed on or after November 29, 2000, or (2) voluntarily published under 35 U.S.C. 122(b). Therefore, this application is examined under 35 U.S.C. 102(e) prior to the amendment by the AIPA (pre-AIPA 35 U.S.C. 102(e)).

2. Claims 1, 2, 7, 8 are rejected under 35 U.S.C. 102(e) as being anticipated by Shufflebotham et al. (US 6,106,678).

Shufflebotham et al. identically the claimed deposition method capable of filling recesses in a substrate, comprising:

- providing a substrate 40 having a recess 38 (Fig.5);
- exposing the substrate 40 to an energized deposition gas, i.e., a deposition gas has been energized into a plasma state while using a plasma assisted CVD deposition method , comprising first O₂ and second SiH₄ (silane) components, to deposit a first layer of SiO₂ in the recess 38 (Fig.5: col. 7, lines 46-53; col. 8, lines 16-17);

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- reducing the ratio of the first component O_2 to the second component SiH_4 , i.e. reducing the O_2 flow, to deposit a second layer of SiO_2 over the first layer of SiO_2 in the recess 38 (Fig.5: col. 8, lines 17-21).

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 3-6, 9-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shufflebotham et al. ('678) in view of Olson et al. (US6,331,494) and applicant's admitted prior art ("AAPA").

Regarding claims 3, 4, 6, 13, 14, 20, 21, Shufflebotham et al. substantially teach the claimed method except that the first component is O_3 and the second component is TEOS (tetraethoxysilane). Olson et al. in an analogous art teach utilizing a silicon-containing precursor such as silane, disilane or tetraethoxysilane and an oxidizing gas reactant such as O_2 , O_3 or N_2O for forming the silicon oxide (col. 2, lines 32-38). In other words, the combination of TEOS and O_3 is an art recognized equivalence of silane and O_2 .

Therefore, it would have been obvious to one artisan in the art at the time of the invention was made to substitute the silane and O_2 of Shufflebotham et al. with the TEOS and O_3 of Olson et al. for forming the silicon oxide layer in the recess. The suggestion for doing so would be to provide the equivalent precursor and oxidizing gas in a reaction chamber and expose the substrate to the energized gas comprising the TEOS and O_3 to deposit the first silicon oxide

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layer in the recess; and reducing the flow ratio of the O_3 to the TEOS to deposit the second silicon oxide over the first silicon oxide.

Regarding claims 5, 9, 15 and 22, the selection of the time interval of the ratio-reducing step is obvious because it is a matter of determining optimum process condition by routine experimentation with a limited number of species. In re Jones, 162 USPQ 224 (CCPA 1955)(the selection of optimum ranges within prior art general conditions is obvious) and In re Boesch, 205 USPQ 215 (CCPA 1980)(discovery of optimum value of result effective variable in a known process is obvious). In such situation, the applicant must show that the particular time interval is critical, generally by showing that the claimed range achieve unexpected results relative to the prior art range. See M.P.E.P. 2144.05 III.

Regarding claims 12, 19 and 23, the selection of the thickness of the first silicon oxide layer is obvious because it is a matter of determining optimum process condition by routine experimentation with a limited number of species. In re Jones, 162 USPQ 224 (CCPA 1955)(the selection of optimum ranges within prior art general conditions is obvious) and In re Boesch, 205 USPQ 215 (CCPA 1980)(discovery of optimum value of result effective variable in a known process is obvious). For example, the thickness of the first silicon oxide may be optimized to a desired range so that the first silicon oxide is thick enough to substantially fill the bottom of the recess while still keeps the recess open. The open-recess is then filled with the second silicon oxide layer, which in turn would avoid the formation of voids in the recess. In such situation, the applicant must show that the particular thickness is critical, generally by showing that the claimed range achieve unexpected results relative to the prior art range. See M.P.E.P. 2144.05 III.

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Regarding claims 10, 11, 16 and 20, the combination of Shufflebotham et al. and Olson et al. fails to teach the recess being between polysilicon gates and having sidewall portions covered with silicon nitride spacers, and wherein the silicon nitride spacers, the polysilicon gates and the other portions of the substrate are covered with a silicon nitride liner. However, it would have been obvious to one of ordinary skill in the art to appreciate that the teachings of Shufflebotham et al. and Olson et al. is a generic example and can be applied to any situations that need to fill the recess having a high aspect ratio as shown in AIPA. In Fig. 1, AIPA teaches a structure having the recesses 27 being between polysilicon gates 22 and having sidewall portions covered with silicon nitride spacers 24, and wherein the silicon nitride spacers 24, the polysilicon gates 22 and the other portions of the substrate are covered with a silicon nitride liner 26; and the recesses 27 are filled with the silicon oxide 28.

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention was made to apply the combined teachings of Shufflebotham et al. and Olson et al. to the AIPA's structure with a reasonable expectation of success since this application is within the level in the art.


Regarding claims 17 and 18, the given teachings of Shufflebotham et al., Olson et al. and AIPA teach the silicon nitride liner 26 comprises reentrant cavities as shown in Fig. 1 of AIPA, and the reentrant cavities are smoothed by the first silicon oxide layer of Shufflebotham et al., wherein the first silicon oxide is formed by TEOS and O_3 as taught by Olson et al.; and the first silicon oxide has a sufficient thickness to fill the reentrant cavities.

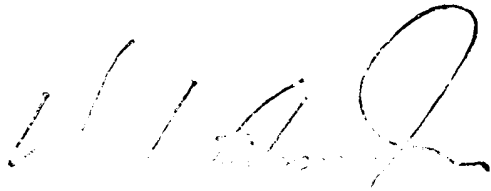
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5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Hsien-Ming Lee whose telephone number is 703-305-7341. The examiner can normally be reached on M-F (9:00 ~ 5:00).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on 703-308-4918. The fax phone numbers for the organization where this application or proceeding is assigned are 703-305-0142 for regular communications and 703-305-0142 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.


Hsien Ming Lee
July 18, 2002


SU. [illegible]
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